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Notes on Livestock Poisoning in Connecticut

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Death of livestock from poisoning represents a tremendous financial loss to farmers and ranchmen of the United States each year. It has been estimated that such losses due to poisonous plants alone reach a yearly total of over $2,000,000(1). Undoubtedly the greater part of this figure represents losses of sheep and cattle on western ranges.

There are no adequate data on which to base any estimate of livestock poisoning in Connecticut, but biological specimens from farm animals suspected of having died of poison are frequently submitted to the Station to determine the cause of death. Such requests are not new in Station experience but they are more numerous in recent years than formerly. This does not mean necessarily that poisoning is more common now than in years past; it is more probable that the increasing attention given to such cases has encouraged investigations of causes from the chemical viewpoint.

Early Investigations

Early reports of the Station reveal investigations of poisoning carried out by Dr. Jenkins of the Station staff, usually in collaboration with Professor Chittenden of the Sheffield Scientific School or with some of his assistants. In 1878 a case of poisoning of horses was reported. No poison was found in the biological specimens but strychnine was found in the feed. This was presumably a case of malicious poisoning because the report further remarks that suspicions in the neighborhood led to such demonstrations that the suspected individual departed.

The loss of eight cows in West Avon is described in the Station report for 1880. Here again no poison was detected in specimens examined, but oxalic acid was found in the feed (corn meal) that was being fed at the time. The same report describes tests for arsenic in corn stalks at the time of harvest. The young corn had been sprayed with Paris green to check ravages of the army worm and it was feared that some residuum of arsenic might be present in the harvested stalks that would render them unsafe for feeding. No trace of arsenic was found in the samples submitted.

Negative results were reported in a case investigated in 1882. In this report also, the unsuitability of galvanized iron utensils as food containers, especially for acid foods, was discussed. It was pointed out that considerable quantities of zinc might be dissolved and produce toxic effects; and the dangerous character of so-called "tin-lined" vessels, in which the "tin" lining was an alloy containing much lead, was noted.

Both arsenic and copper were found in biological specimens examined in 1883, indicating poisoning from Paris green. In 1904, lead, equivalent to 3.4 grams of lead sulphate, was found in specimens of stomach contents, liver and blood of cattle. Painting had been done on the premises by an advertising firm and the animals had licked the fresh paint, or had eaten vegetation on which paint had been spilled.

In the intervening years since that time, specimens have been examined probably in about the same order of frequency. Since 1918 over 700 examinations have been made. This number does not represent the same number of cases because often several specimens are connected with one and the same case.

Common Metallic and Mineral Poisons

The causes of livestock poisoning fall in two general classes. The first includes poisons that are present in materials commonly used on the farm and which, through inadvertence or carelessness, are left where animals find access to them, or which by accident may contaminate their feed. Such losses can be guarded against by due care and alertness on the part of the owner who, in most instances, fully appreciates the dangerous character of such materials. Deliberate poisoning through spite or malicious intent are beyond his ordinary precautions, but such cases are relatively few in number.

Poisoning from materials in this group can almost always be traced to paints, insecticides or rodent poisons, and less frequently to fertilizer materials or industrial wastes. It is well known that animals will lick newly painted surfaces or discarded paint containers, and since many paints contain lead the results may be fatal. When both lead and arsenic are found, the probable source is spray material that has contaminated the grass or hay on which animals have fed. Arsenic alone is an indication that the use of non-lead arsenicals, such as weed killers, is responsible. Such a case was investigated by us during the past year. Biological specimens showed large amounts of arsenic but no lead. Inquiry revealed that animals being driven from one pasture to another crossed a railroad where the right-of-way had been sprayed to kill weeds and other vegetation. Some of the animals had tarried long enough to browse upon the poisoned foliage, with fatal results.

Fertilizers after application present no hazard because they become mixed with soil and are largely dissolved by rainfall; but nitrate salts exposed on the surface of the ground will poison animals and poultry if eaten in sufficient quantity. Animals should not be allowed to lick fertilizer bags, particularly those containing nitrate salts, or to drink water in which fertilizer bags have been washed. Castor pomace, a common fertilizer material should also be kept out of reach of farm animals.

Rodent exterminators, ant pastes and similar preparations may be dangerous to both livestock and poultry. Yellow phosphorus, the active ingredient in many rat pastes, is often found in biological specimens that we have examined; arsenic and thallium also have been detected. When

strychnine is found, poison bait may be suspected. Poisoning from fluorides is uncommon but when found the most probable explanation is contamination of feed with roach powder (sodium fluoride or fluosilicates), used on the premises. Incidentally, such accidental poisoning involves human beings more often than domestic animals, and it arises in the home or institutional kitchen from mistaking roach powder for food stuffs.

Among miscellaneous cases of poisoning may be cited a sample of horse feed containing mercury. The inadvertent feeding of seed oats that had been disinfected with bichloride of mercury was the explanation. Excessive intake of common salt may be dangerous to poultry, especially young chicks. Specimens from the crop and gizzard of a duck were found to contain 3.23 per cent of salt, and the feed sample submitted (said to be mill sweepings) contained over 18 per cent of salt. Cyanide was found in a sample of water from a brook where animals died soon after drinking. Contamination of the stream by industrial waste liquors was indicated.

Poisonous Plants

Poisonous plants comprise the second group of causes responsible for losses of farm animals. Scientific texts, notably those by Pammel(2) and Muenscher(3), list and describe such plants and discuss their poisonous principles as well as their effects on animals. There are numerous government publications giving comprehensive information on the subject for the benefit of farmers and ranch owners. Bulletins of more restricted scope have been issued by state experiment stations and departments of agriculture.

Among the first, if not the earliest, of these publications are those by V. K. Chestnut (4, 5 and 6), who was a botanist as well as a chemist and therefore especially qualified for his task. A later bulletin by Chestnut and Wilcox (7) gives an exhaustive account of an investigation of poisonous plants in Montana. A monograph by A. B. Clawson (8) gives a digest in tabular form of essential information concerning the principal poisonous plants in the United States; and a revision of this table by Huffman and Couch(9) appears in the Yearbook of Agriculture for 1942. These, and other sources(10) of information have been consulted and they are cited here for the reference of those interested.

The number of poisonous plants in the United States is rather appalling. Muenscher lists some 400 species. Chestnut cited 52 plants known to be poisonous, 39 probably poisonous and 37 suspected of being poisonous. Clawson's table includes about 40 of the principal poisonous plants, as does the revision by Huffman and Couch.

Several considerations serve to lessen the seriousness of this picture and afford some reassurance to stock owners. Not all of the poisonous plants are likely to be found in any one locality; and they are not all equally dangerous. Some are toxic at certain stages of growth and, apparently, harmless at other times. In some instances relatively large quantities of plant material—larger than an animal would ordinarily consume—must be eaten to produce serious effects. Some plants appear to be poisonous only

to certain species of animals. To some extent unpalatability of poisonous plants is an automatic safeguard to animals. Open pastures will harbor fewer plants of poisonous character and be less hazardous than woodland pastures. Feeding conditions are an important factor. In spring pasturage young poisonous plants may be concealed in new grass and eaten eagerly. Later in the season when pasturage is short by reason of drought or over-grazing, animals will explore the vegetation along fences and eat foliage not ordinarily attractive to them. Poisoning is most likely to occur under these conditions.

Water-hemlock (*Cicuta maculata*). Root system at left, and flowering top.

A "Catalog of Flowering Plants and Ferns of Connecticut"(11) gives a comprehensive picture of plants found in this State but it does not discuss poisonous plants beyond passing reference to the poisonous properties of some of them.

The data summarized in the accompanying table are taken from sources already cited, notably Huffman and Couch, the earlier summary by Clawson, and from Muenscher's text. Without pretense as to completeness, the

Name of plant	Where found	Parts that usually cause poisoning	Poisonous principle
Arrow Grass (*Triglochin maritima* L.)	Salt marshes and wet places	Leaves and stems	Prussic acid
Bracken (*Pteridium*)	Thickets, hills and woods	Fronds	Unknown
Cherry, wild (*Prunus*)	Dry rocky woods and old fields	Leaves	Glucoside yielding prussic acid
Dutchman's breeches (*Dicentra cuculla-ria* (L.) Berhn.)	Woodlands	Leaves and stems	Cucularine and other alkaloids
Hellebore, white (*Veratrum viride* Ait.)	Wet or swampy ground	Plants and seeds	Several alkaloids
Horsetail (*Equisetum*)	Wet meadows	Tops	Equisetin
Jimson-weed (*Datura stramonium* L.)	Widespread in cultivated fields and waste lands	All parts of plant	Hyoscine and related alkaloids
Laurel, mountain (*Kalmia latifolia* L.)	Woods and hillsides	Leaves	Andromedotoxin
Laurel, sheep (*Kalmia angustifolia* L.)	Moist soil; hillsides and swamps	Leaves	Andromedotoxin
Lupine (*Lupinus perennis* L.)	Widespread	Leaves and seeds	Lupanine or related alkaloids
Nightshade, black (*Solanum nigrum* L.)	Waste or cultivated lands	Green fruit and leaves	Solanine
Poison-hemlock (*Conium maculatum* L.)	Widespread	Fruits and leaves	Coniine
Pokeweed (*Phytolacca americana* L.)	Woods, pastures and waste lands	All parts of plant, especially root	Alkaloid and probably saponin
Ragwort, or groundsel (*Senecio*)	Roadsides, pastures and waste places	Leaves and stems	Alkaloids
Rattle Box (*Crotalaria sagittalis* L.)	Sandy soils	Plants and seeds	Alkaloid
Snakeroot, white (*Eupatorium urticaefolium* Reich.)	Woodland, shaded pastures and fields	Leaves and stems	Tremetol, an alcohol
Water-hemlock (*Cicuta maculata* L.)	Wet places	All parts of plant, especially rootstock	Cicutoxin, a resinoid

Animals most commonly poisoned	Conditions under which poisoning occurs	Symptoms
Sheep and cattle	Eating about 1 per cent of animal's weight of green plants within a few minutes	Difficult breathing, spasms, illness of short duration
Horses and cattle	Eating 5 pounds daily for about a month	Horses: lack of control of legs, weakness Cattle: hemorrhages in various parts of body
Sheep and cattle	Eating 1 per cent of animal's weight of green or wilted leaves in short time	Difficult breathing, spasms, illness of short duration
Cattle	Feeding on plant, particularly in spring and early summer	Trembling, frothing at mouth, convulsions
Sheep and other animals, poultry	Feeding on plants or seeds	Salivation, purging, tremors, paralysis
Horses and sheep	Eating the plant in hay	Weakness, craving for the plant, diarrhea, loss of flesh, lack of control of legs
Cattle, sheep and horses	Feeding on plants or unripe seeds	Nausea, dilated pupils, convulsions
Cattle, sheep and goats	Eating 0.4 per cent of animal's weight of green plants in a day	Salivation, vomiting, weakness
Cattle, sheep and goats	Eating 0.2 per cent of animal's weight of green plants in a day	Salivation, vomiting, weakness
Sheep and cattle	Eating 0.5 per cent of animal's weight of green plant or fruit in a day	Sheep: nervousness, labored breathing, convulsions, frothing at the mouth Cattle: weakness and trembling
Cattle, sheep, goats and poultry	Feeding on leaves and especially on unripe berries	Narcosis and paralysis; also salivation, vomiting, bloating and diarrhea
Sheep and cattle	Seldom eaten when other feed is available	Nervous tremors, weakness, respiratory paralysis
Animals and humans	Feeding on plants, especially roots	Purging and spasms
Cattle and horses	Feeding for several days on poisonous species	Nervous disturbances, diarrhea, jaundice, emaciation
Horses, cattle and poultry	Feeding on plants, fresh or dried, and on seeds	.....
Cattle and sheep	Feeding on plant for several days	Marked trembling and weakness
Cattle especially, also horses, sheep and swine	Eating very small quantities	Frothing at mouth, violent spasms, evidence of pain

plants listed probably include the principal ones to be found here which are positively dangerous to livestock, as well as those which should be at least regarded with suspicion.

Judging from cases that have come to our attention the most probable sources of poisoning from plants in this State are the water-hemlock, sheep laurel, mountain laurel, wild cherry and nightshade.

Water-hemlock belongs to the genus *Cicuta* of which there are several species, all poisonous. It is a perennial plant with jointed stems frequently showing purple spots. If the root or root stock is cut, a yellowish oil of peculiar odor exudes. The various species of this plant are said to be the most violently poisonous of any found in the United States, the roots and root stocks being most dangerous. The plant is especially hazardous in early spring when the soil is moist and the roots are easily dislodged by grazing animals. Stock losses are chiefly among cattle, but horses, sheep and hogs are susceptible. The poisoning of human beings as well as of domestic animals has been reported.

Sheep laurel and **mountain laurel** are species of *Kalmia*, and the leaves of both are poisonous. Sheep laurel is a low shrub, while the familiar mountain laurel often attains considerable height. The leaves are not likely to be eaten by stock except when other forage is scarce.

The leaves of the **wild cherry**, *Prunus*, are poisonous because they contain a glucoside which yields prussic acid through the action of an enzyme also present in the leaves. Howard(12) investigated three species and found *P. serotina* the most poisonous, and *P. virginiana* (choke-cherry) and *P. pennsylvanica* dangerous. He found young succulent leaves more poisonous than leaves from older growth, and the prussic acid content of wilted leaves higher than in fresh leaves. This observation supports the general impression that wilted leaves are more dangerous than fresh ones. Prussic acid is present in very small amounts in thoroughly dried leaves so that such as might be present in well-cured hay would probably not be a serious menace.

There is some evidence that sugars reduce the amount of prussic acid liberated from leaves, either by combination with it or by retarding effect on the action of the enzyme, and this suggests that the kind and amount of food in the digestive tract of the animal is another factor that enters into the picture.

Regardless of technical considerations as to what constitute optimum conditions for the formation of prussic acid and the absorption of it by the animal, the practical aspect of the matter, so far as animals in pasture are concerned, is that wild cherry leaves are potentially dangerous. Fatalities are most likely to occur in the case of hungry animals eating substantial quantities of wilted young leaves in a short space of time.

Black nightshade, *Solanum nigrum* L., is also known as common nightshade, deadly nightshade, garden nightshade and poison berry. It is an annual plant, widely distributed throughout the United States and

southern Canada, and found in waste or cultivated land and in open woods. The plant bears purple or black berries containing many seeds. Both the leaves and the berries are poisonous, the berries especially so when unripe.

Another variety of nightshade, *Solanum dulcamara* L. is known as **blue nightshade** or woody nightshade. It appears to be less poisonous than black nightshade. Poisoning from both species is attributed to solanine, a principle also present in a related plant, the common potato. Potato sprouts, and tubers that have turned green by exposure to the sun, have been reported as the cause of poisoning in both cattle and humans.

General Procedure and Results

The results of laboratory examinations of biological specimens are often negative. Such results are not without some value, however, because they aid the investigations to the extent of excluding the common volatile, metallic, mineral or alkaloidal poisons, and indicate the probability of mortality from other causes. In a fair proportion of specimens poisonous substances in amounts of possible or probable significance are found. Thus in the three-year period of 1939 to 1941, of 215 specimens examined, positive tests were obtained in 97, or 45 per cent, of them.

Autopsies should be made by a veterinarian or an animal pathologist whenever possible. Indications of disease or of some abnormal physiological condition may then be revealed, and much laborious analytical work saved. Such information is not always available, but in 17 cases included in the above three-year period, positive chemical findings were supplementary to pathological examinations made by the Department of Animal Diseases at the Storrs Station. In one of these a diaphragmatic hernia was found. Two pounds of Epsom salts had been given the animal (a pig) in treatment. Chemical tests revealed nothing of significance in the stomach contents except much sulphate. The medication may have caused or contributed to the condition found in that case. In this connection it may be remarked that for purgative purposes Epsom salt should be dissolved in a large amount of water. It is very toxic if administered in too concentrated solution. In the remaining 16 cases pathological explanations were indefinite or lacking. Added weight was thus given to the chemical poisons as probable causes of mortality. The poisons found were lead, arsenic, strychnine and an unidentified alkaloid.

The common metallic and mineral poisons can be detected and determined in biological material by adequate chemical methods, but this is not true of poisonous plant principles. Nicotine and strychnine offer no difficulty, but when these are found the immediate source is very likely commercial preparations of the alkaloids rather than the native plants. Other plant principles may be isolated in the form of alkaloidal residues and purified to some degree, but color reactions and other tests must be interpreted with much caution. Decomposition products in the biological specimen itself may confuse the picture here.

Circumstantial evidence found on visiting pastures is generally more convincing. If plants known to be dangerously poisonous are found, and

they show evidence of having been browsed upon, the cause of illness or mortality is reasonably clear. Such evidence has indicated water-hemlock in several cases that we have investigated. In other cases evidence has pointed to laurel and wild cherry leaves. Macroscopic examination of specimens of stomach contents has also furnished clues in some instances.

When farm animals die, knowledge of the causes is chiefly valuable in that it enables the owner to avoid further losses of like character. In rare cases it may serve to fix responsibility and afford a basis for recovery of damages through civil action, or for prosecution if criminal responsibility is involved. Or, again, it may serve to remove unwarranted suspicion. An illustration of such a situation may be cited from our experience. A farmer had lost several cows and he was convinced in his own mind that the animals had been poisoned by eating grass or foliage contaminated with lead arsenate, and that a commercial spraying service which had been operating in his vicinity was responsible. To be fully prepared before lodging complaint he sent biological specimens from the animals to the laboratory for examination. No evidence of lead or of arsenic was found. A visit to the farm and a survey of the pasture revealed luxuriant growths of a poisonous plant (nightshade), and unmistakable evidence that the plants had been browsed upon freely. There was no evidence at all of arsenical poisoning, but suspicion pointed strongly to plant poisoning.

Some Safeguards Against Poisoning

As already suggested, care and alertness in the handling and disposal of common poisonous materials used on the farm would have prevented most of the animal mortality that we have encountered where poisons were clearly indicated. Trash piles and rubbish dumps are positive hazards that we have found repeatedly. They should be fenced off or otherwise isolated so that animals cannot gain access to them. Garden refuse which may bear residues of insecticides, and clippings from poisonous ornamental plants and shrubs, should not be thrown into pastures or left beside fences where animals may reach them. Nor should poisonous refuse be left where it may leach or drain into drinking places.

The large number of plants known, or reputed, to be poisonous to animals carries alarming implications. But there are considerations that tend to mitigate the dangers and they are pointed out in this discussion. Our purpose is to call the attention of livestock owners to the possibilities of harm from this source and to add such information as our own experience affords.

Complete eradication of poisonous plants is impossible. Only a trained botanist would recognize them all; and the labor and expense involved in eradication would be prohibitive. The number of really dangerous plants is probably relatively few in any given locality, and as a measure of prudence the livestock owner should familiarize himself with as many of these as possible. Certainly he should know the water-hemlock and eradicate it or fence off pasture areas where it abounds.

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